morrow

Geotechnical Investigation Report

PROPOSED DEVELOPMENT

826 VICTORIA ROAD, RYDE NSW

Prepared for:

THE TRUSTEES OF THE ROMAN CATHOLIC CHURCH FOR THE DIOCESE OF SAINT MARON SYDNEY

Reference: P2566_ 01

26 May 2022

Morrow Geotechnics Pty Ltd | ABN 42 605 892 126
PO Box 4069, Carlton NSW 2218
P: 0405 843 933 | E: info@morrowgeo.com.au

1 PROJECT BACKGROUND

This report presents the results of a Geotechnical Investigation undertaken by Morrow Geotechnics Pty Ltd to provide geotechnical advice and recommendations for the proposed development at 826 Victoria Road, Ryde NSW (the site).

1.1 Proposed Development

Architectural drawings for the proposed development have been prepared by Altis Architecture for Project No. 3110.01 dated 8 December 2021. Based on the drawings provided, Morrow Geotechnics understands that the proposed development involves construction of a daycare facility over a single level basement. Excavation for the proposed basement level is expected to extend to a depth of approximately 3.0 m below ground level (mBGL).

1.2 Investigation Intent

The intent of the investigation is to provide geotechnical advice and recommendations specific to the ground conditions observed at site for the proposed development. These recommendations include:

- Foundation advice along with relevant geotechnical design parameters;
- Excavation and shoring advice along with relevant geotechnical design parameters;
- Approaches to minimise the impact of the proposed development through vibration, ground movement or groundwater drawdown;
- Other relevant geotechnical issues which may impact construction; and
- Recommendations for further geotechnical input during construction.

2 SITE DESCRIPTION

2.1 Published Geological Mapping

Information on regional sub-surface conditions, referenced from the Department of Mineral Resources Geological Map Sydney 1:100,000 (Geological Series Sheet 9130) indicates that the site is underlain by (Rwa) Ashfield Shale of the Wianamatta Group, which is typically comprised of black to dark-grey shale and laminite.

2.2 Published Soil Landscape Mapping

The Soil Conservation Service of NSW Sydney 1:100,000 Soil Landscapes Series Sheet 9130 (1st Edition) indicates that the erosional landscape at the site likely comprises the Glenorie Landscape. This landscape type typically includes undulating to rolling hills on Wianamatta Group shales with slopes of 5-20 %. Soils are moderately deep (< 0.7 to 1.5 m) red and brown podzolic soils on upper slopes. These soils are noted to present high soil erosion hazard, localised impermeable highly plastic and moderately reactive soil.

3 OBSERVATIONS

3.1 Investigation Methods

Fieldwork for the geotechnical investigation was carried out on 25 May 2022 and comprised the drilling of two boreholes (BH1 and BH2) to depths of 7.0 and 5.5 mBGL respectively. The borehole locations were measured relative to existing site features and approximate borehole locations are shown on **Figure 1**.

BH1 and BH2 were drilled using a trailer-mounted drilling rig and were advanced in soil and rock using solid flight augers with a Tungsten Carbide (TC) drill bit. Dynamic Cone Penetrometer (DCP) tests were carried out adjacent to borehole locations to assess soil strength. On completion the boreholes were backfilled with cuttings to the ground surface.

A Geotechnical Engineer was present throughout the drilling operations to undertake testing, record test results and log the materials encountered.

3.2 Subsurface Conditions

The ground conditions at the site are characterised by fill and residual soil overlying shale bedrock. Detailed borehole logs are presented in **Appendix A.** A summary of the subsurface conditions across the site is presented in **Table 1** below.

TABLE 1 GROUND CONDITIONS

Unit		Approx. Depth Range of Unit [1] mBGL		Generalised Description
		BH1	BH2	
1	**Pavement / Fill**	0.0 to 1.0	0.0 to 1.2	Pavement above a fill layer that is generally a silty SAND to sandy CLAY. Fill within Unit 1 was observed to be uncontrolled and poorly compacted.
2	**Residual Soil**	1.0 to 3.4	-	Medium to high plasticity silty clay with some sand and ironstone gravel. Unit 2 is of stiff to hard consistency with DCP blowcounts between 2 and 9 per 100mm
3	**Class V-IV Shale**	3.4 to 6.3	1.2 to 5.0	SHALE, clay seams present, highly weathered, inferred very low strength.
4	**Class III Shale**	6.3 +	-	SHALE, distinctly weathered, low strength, grading stronger with depth.

Notes:

1 Depth ranges shown are based on material observed within test locations and will vary across the site.
2 A 0.5 m thick Class V Shale band exists within Unit 4 in BH3 at 4.2 mBGL

3.3 Groundwater Observations

Seepage was noted at a depth of 6.3 mbgl in BH1 during the investigation. Minor seepage should be expected from the soil/rock interface and from within open joints in the rock mass during excavation as a response to surface water infiltration.

4 DISCUSSIONS AND RECOMMENDATIONS

4.1 Excavations and Shoring

4.1.1 Excavation Retention Design

Temporary batters may be considered for retention during basement excavation only where adequate room for full batter construction is available. Temporary batter slopes of 1V:1H will be possible for all units above the water table provided that surface water is diverted away from the batter faces and batter heights are kept to less than 4m. Where batters extend beyond 4 m height benching may be required and further advice should be sought from a qualified geotechnical engineer. Permanent batters of 2H:1V may be employed for excavation design above the water table. Permanent batters will require surface protection or revegetation to prevent erosion and slaking.

Where excavations extend beneath the zone of influence of nearby structures, services or pavements, or where site constraints do not allow the construction of temporary batters, basement retention will be required. For design of flexible shoring systems a triangular pressure distribution may be employed using the parameters provided in **Table 2**. For design of rigid anchored or braced walls, a trapezoidal earth pressure distribution should be used with a maximum pressure over the central 50% of the supported height of 0.65.Ka.γ.H (kPa), where 'H' is the effective vertical height of the wall in metres.

TABLE 2 RETENTION DESIGN PARAMETERS

Material		Unit 1 Pavementl / Fill	Unit 2 Residual Soil	Unit 3 Class V-IV Shale	Unit 4 Class III Shale
Earth Pressure Coefficients	At rest, K_o	0.55	0.50	0.30	-
	Passive, K_p	2.66	3.00	4.00	300 kPa ultimate stress block
	Active, K_a	0.38	0.33	0.20	-
Bulk Unit Weight (kN/m^3)		16	18	22	24

Earth pressure coefficients with **Table 2** are provided on the assumption that the ground behind the retaining wall is flat and drained. For cases where the ground profile rises at more than 5^o behind the retaining system detailed design input should be sought from a geotechnical engineer.

Surcharge loads on retention structures may either be modelled directly through finite element inputs in programs such as Plaxis or Wallap, or they may be calculated using a rectangular stress block with an earth pressure coefficient of 0.5 applied to surcharge loads at ground surface level. The retaining walls should be designed to withstand hydrostatic pressure below the level of Unit 3 shale unless permanent drainage is incorporated in the wall design.

4.1.2 Soil and Rock Excavatability

The expected ability of equipment to excavate the soil and rock encountered at the site is summarised in **Table 3**. This assessment is based on available site investigation data and guidance on the assessment of excavatability of rock by Pettifer and Fookes (1994). The presence of medium to high strength bands in lower strength rock and the discontinuity spacing may influence the excavatability of the rock mass.

TABLE 3 SOIL AND ROCK EXCAVATABILITY

Unit	Material	Excavatability
1	**Topsoil / Fill**	Easy digging by 20t Excavator
2	**Residual Soil**	Easy digging by 20t Excavator.
3	**Class V-IV Shale**	Moderate to hard ripping by 20t Excavator.
4	**Class III Shale**	Hard ripping by 20t Excavator. Hydraulic hammering will be required where medium strength shale is encountered within the excavation depth.

The excavation methodology may also be affected by the following factors:

- Scale and geometry of the excavation;
- Availability of suitable construction equipment;
- Potential reuse of material on site; and
- Acceptable excavation methods, noise, ground vibration and other environmental criteria.

Where vibration intensive works such as hydraulic hammering of competent rock or driven piles are proposed contractors should make an assessment of the potential impact of their works on the basis of the borehole logs, core photographs and point load data. Monitoring of construction induced vibration should be undertaken at the commencement of such activities at the nearest vibration receptor in consultation with the project superintendent and geotechnical engineer. On the basis of trials at the commencement of works a construction methodology may be proposed to limit peak particle velocities (ppv) to acceptable levels. In the absence of ppv guidelines from affected asset owners, Morrow Geotechnics recommends the following limits be placed on vibrations:

- 20 mm/s for commercial or industrial structures;
- 10 mm/s for residential structures;
- 3 mm/s for structures which are particularly susceptible to vibration such as heritage buildings.

If vibration levels are found to be unacceptable during the trial, it may be necessary to adopt vibration mitigation measures such as:

- The use of smaller excavation plant and hydraulic hammers;
- Saw cutting of the perimeter of the excavation;
- Hammering at 50% capacity in short bursts to prevent the buildup of resonant frequencies;
- The use of low vibration techniques such as rotary grinders or chemical rock splitting.

4.1.3 Groundwater Management

For excavations at the site it should be expected that seepage water will be encountered at the soil/rock interface and in joints and bedding partings within the bedrock. Seepage in shale bedrock may be assumed as typically flowing downwards toward local drainage lines or regional water table, along horizontal bedding planes and sub-vertical joints. The rock mass permeability will be governed by the joints, faults and bedding planes.

Given the observed relatively intact bedrock with tight defects across the site it is anticipated that the permeability of the rock mass will be relatively low and that seepage inflows will be controlled by sump and pump methods.

4.2 Foundations

All proposed footings must found below Unit 1 material to prevent differential settlement on topsoil and fill containing compressible material. Selection of footing types and founding depth will need to consider the risk of adverse differential ground movements within the foundation footprint and between high level and deeper footings. Unless an allowance for such movement is included in the design of the proposed development we recommend that all new structures found on natural materials with comparable end bearing capacities and elastic moduli.

Shale strength varied across the site. It is recommended that footings at basement excavation level are designed on bearing pressure parameters for Unit 3 material.

The parameters given in **Table 4** may be used for the design of pad footings and bored piles.

TABLE 4 FOUNDATION DESIGN PARAMETERS

Material		Unit 1 Topsoil / Fill	Unit 2 Residual Soil	Unit 3 Class V-IV Shale	Unit 4 Class III Shale
Allowable Bearing Pressure (kPa)		N/A	250	1000	1500
Ultimate Vertical End Bearing Pressure (kPa)		N/A	750	3000	4500
Elastic Modulus (MPa)		4	25	120	200
Allowable Shaft Adhesion (kPa)	In Compression	0	15	70	150
	In Tension	0	7.5	35	75

The bases of all foundation excavations must be cleaned of loose debris and water and inspected by a suitably qualified Geotechnical Engineer prior to pile construction to verify that ground conditions meet design assumptions. Side adhesion values provided in **Table 4** assume there is intimate contact between the pile and foundation material as specified in Pells (2004). Design engineer to check both 'piston' pull-out and 'cone' pull-out mechanics in accordance with AS4678:2002 Earth Retaining Structures.

4.2.1 Limit State Design

For limit state design in accordance with AS2159 Morrow Geotechnics recommends that a Preliminary Geotechnical Strength Reduction Factor (GSRF) of 0.4 is used for the design of piles if no allowance is made for pile testing during construction. Should pile testing be nominated, the GSRF may be reviewed and a value of 0.55 to 0.65 may be expected.

Ultimate geotechnical strengths are provided for use in limit state design. Allowable bearing pressures are provide for serviceability checks. These values have been determined to limit settlements to an acceptable level for conventional building structures, typically less than 1% of the minimum footing dimension.

4.3 AS1170 Earthquake Site Risk Classification

Assessment of the material encountered during the investigation in accordance with the guidelines provided in AS1170.4-2007 indicates an earthquake subsoil class of Class B_e – Rock for the site.

5 CONCLUSION

On the basis of this geotechnical investigation it may be concluded that the site is geotechnically suitable for the proposed development. Structural designs will be geotechnical suitable and adequate for the site provided that they are carried out in accordance with the recommendations of this report.

6 ADDITIONAL GEOTECHNICAL INPUT

Further input from a geotechnical professional during design and construction is advised in order to ensure a cost-effective design which can be constructed safely and efficiently. Areas for geotechnical input should include:

- Geotechnical design input during structural design including Finite Element Analysis of ground movements for the protection of adjacent structures and properties.
- Geotechnical inspection of piling works to verify pile socket conditions and confirm the geotechnical site model.
- Geotechnical inspections of foundation of foundation material to confirm allowable bearing pressures.
- Regular inspections of battered and unsupported excavations, where proposed, to assess excavation conditions and confirm the suitability of the proposed methodology.

7 STATEMENT OF LIMITATIONS

The adopted investigation scope was limited by the investigation intent. Further geotechnical inspections should be carried out during construction to confirm the geotechnical model provided in this report.

Your attention is drawn to the document “Important Information”, which is included in **Appendix B** of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Morrow Geotechnics, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

8 REFERENCES

AS1726:1993, Geotechnical Site Investigations, Standards Australia.

AS2159:2009, Piling – Design and Installation, Standards Australia.

Chapman, G.A. and Murphy, C.L. (1989), Soil Landscapes of the Sydney 1:100,000 sheet. Soil Conservation Services of NSW, Sydney.

NSW Department of Mineral Resources (1985) Sydney 1:100,000 Geological Series Sheet 9130 (Edition 1). Geological Survey of New South Wales, Department of Mineral Resources.

Pells (2004) Substance and Mass Properties for the Design of Engineering Structures in the Hawkesbury Sandstone, Australian Geomechanics Journal, Vol 39 No 3

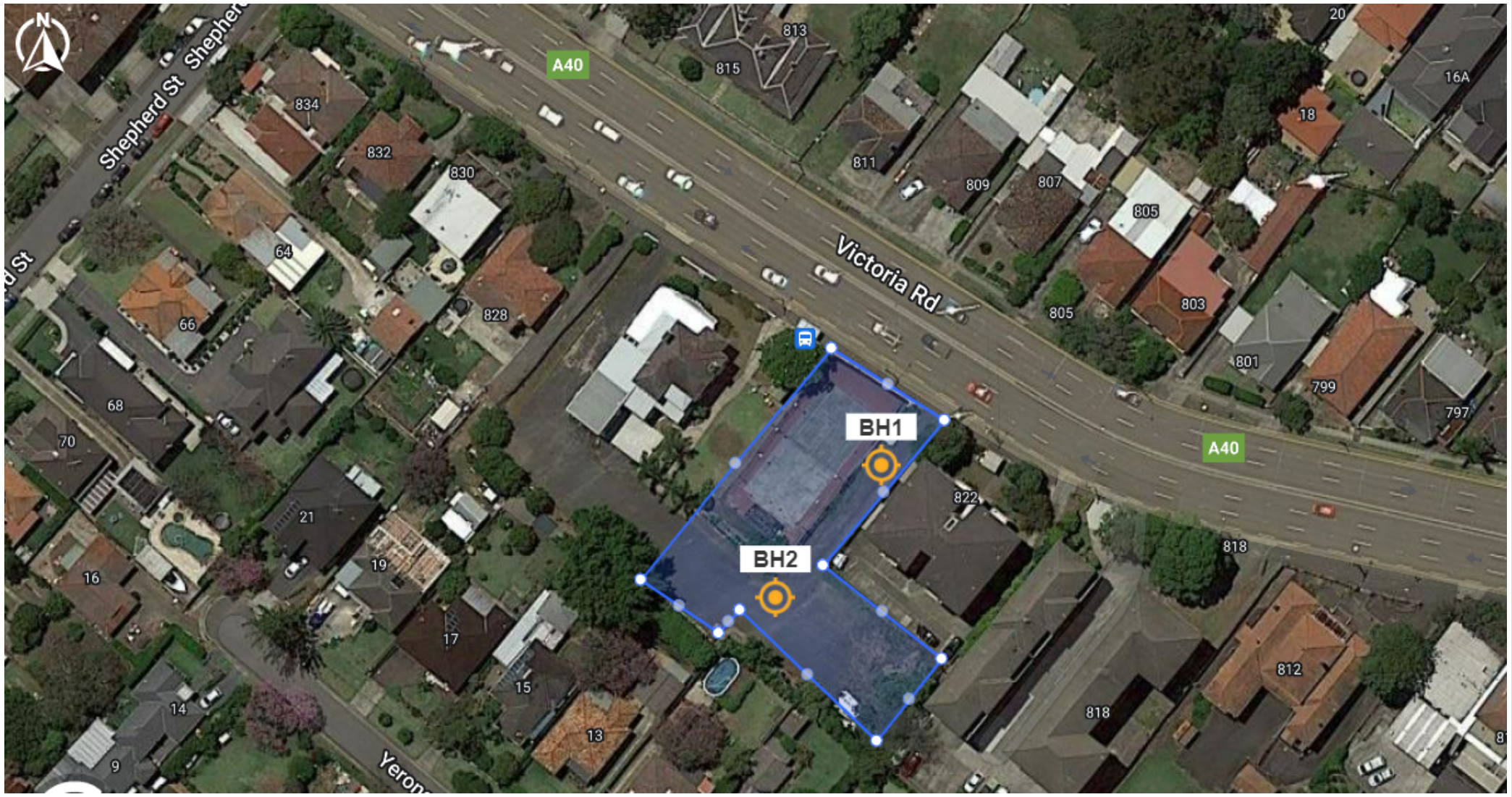
9 CLOSURE

Please do not hesitate to contact Morrow Geotechnics if you have any questions about the contents of this report.

For and on behalf of Morrow Geotechnics Pty Ltd,

Rhiannon McKeon
Senior Engineering Geologist
BSc (Hons) Geology and Geophysics MAIG (7937)

Alan Morrow
Principal Geotechnical Engineer
BE (Civil) BSc MIEAust CPEng NER (2474672)



morrow
0405 843 933
Bellambi, NSW
info@morrowgeo.com.au

Map description	Borehole Location Plan - 826 Victoria Road, Ryde NSW		
Site location	826 Victoria Road, Ryde NSW		
Client	The Trustees of the Roman Catholic Church for the Diocese of Saint Maron Sydney		
Project name	826 Victoria Road, Ryde		
Project No	P2566	**Scale**	Not to Scale

Appendix A

BOREHOLE LOGS AND EXPLANATORY NOTES

Morrow Geotechnics
Bellambi, NSW
Phone: 0405 843 933

Engineering Log - Borehole

Borehole No: BH1

UTM	: 56H	Driller Rig	: Trailer Mounted ADT	Job Number	: P2566
Easting	: 324031.7	Driller Supplier	: Tony Smith	Client	: The Trustees of the Roman Catholic Church for t
Northing	: 6256706.8	Logged By	: Jordan Andonoski	Project	: 826 Victoria Road, Ryde
RL	: N/A	Reviewed By	: Rhiannon McKeon	Location	: 826 Victoria Road, Ryde NSW
Total Depth	: 7m	Date	: 25/05/2022		

Drilling Method	Water	Samples	DCP	Soil Origin	Graphic Log	Classification Code	Depth (m)	Material Description	Consistency	Moisture	Observations
ADT			0 0 0 4 4 3 3 4 3 2	Pavement / Fill		ASP / SBC / SC	0.04 / 0.2 / 0.5 / 1	ASPHALT (ASP) / SUBBASE COURSE (SBC) / Clayey to silty SAND (SC) : Medium Dense, Fine to Medium grained, Dark Brown, Low plasticity clay, Moist.	MD	M	
			2 3 3 2 3 3 3 3 5 4 3 4 5	Residual		CI-CH	1 / 1.5 / 2 / 2.2	Silty to gravelly CLAY (CI-CH) : Stiff to Very Stiff, Medium to High plasticity, Red Orange Brown, Fine to Medium sized gravel, trace Fine to Medium grained sand, w < PL. (ironstone gravels)	St-VSt	w < PL	
			6 8 23 25	Residual		CI	2.5 / 3 / 3.4	Sandy to gravelly CLAY (CI) : Very Stiff to Hard, Medium plasticity, Light Grey Orange, Fine to Medium sized gravel, Fine to Medium grained sand, w<PL.	VSt-H	w < PL	
				Rock		SHA	3.5 / 4 / 4.5 / 5	SHALE : Highly Weathered, Very Low strength, grained, Grey, Distinct .	VLS		
	▶			Rock		SHA	5 / 5.5 / 6 / 6.3	SHALE : Moderately Weathered, Very Low to Low strength, grained, Grey, Distinct .	VLS-LS		
				Rock		SHA	6.3 / 6.5 / 6.6	SHALE : Moderately Weathered, Low to Medium strength, grained, Grey, Distinct .	LS-MS		
				Rock		SHA	6.6 / 7	SHALE : Moderately Weathered, Low to Medium strength, grained, Grey Black, Distinct .	LS-MS		
							7 / 7.5 / 8	**BH1 Terminated at 7m (Reached Target Depth)**			

Morrow Geotechnics
Bellambi, NSW
Phone: 0405 843 933

Engineering Log - Borehole

Borehole No: BH2

UTM	: 56H	**Driller Rig**	: Trailer Mounted ADT	**Job Number**	: P2566
Easting	: 324013.6	**Driller Supplier**	: Tony Smith	**Client**	: The Trustees of the Roman Catholic Church for t
Northing	: 6256683.6	**Logged By**	: Jordan Andonoski	**Project**	: 826 Victoria Road, Ryde
RL	: N/A	**Reviewed By**	: Rhiannon McKeon	**Location**	: 826 Victoria Road, Ryde NSW
Total Depth	: 5.5m	**Date**	: 25/05/2022		

Drilling Method	Water	Samples	DCP	Soil Origin	Graphic Log	Classification Code	Depth (m)	Material Description	Consistency	Moisture	Observations
ADT	GWNE		0 0 0 3 3 4 4 3 3 2 4 3 8 19 30	Pavement Fill Pavement Rock Rock Rock		ASP CI-CH SBC SHA SHA SHA	0.2 0.4 0.5 1 1.2 1.5 2 2.5 3 3.5 4 4.2 4.5 4.7 5 5.5 6 6.5 7 7.5 8	ASPHALT (ASP) Silty to sandy CLAY (CI-CH) : Firm, Medium to High plasticity, Orange Brown Red, Fine to Medium grained sand, with Fine to Medium sized gravel, (ironstone gravel) SUBBASE COURSE (SBC) SHALE : Highly Weathered, Very Low strength, grained, Orange Light Grey, Distinct . (ironstone gravel) SHALE : Extremely Weathered, Hard, Low plasticity, Light Grey, with Fine sized gravel, w < PL. (ironstone banding, inferred extremely low strength.) SHALE : Highly Weathered, Very Low to Low strength, grained, Grey, Distinct . **BH2 Terminated at 5.5m (Reached Target Depth)**	F H-VLS H VLS-LS	D w < PL	

Soil and Rock Logging Explanatory Notes

GENERAL

Information obtained from site investigations is recorded on log sheets. The "Cored Drill Hole Log" presents data from an operation where a core barrel has been used to recover material - commonly rock. The "Non-Core Drill Hole - Geological Log" presents data from an operation where coring has not been used and information is based on a combination of regular sampling and insitu testing. The material penetrated in non-core drilling is commonly soil but may include rock. The "Excavation - Geological Log" presents data and drawings from exposures of soil and rock resulting from excavation of pits, trenches, etc.

The heading of the log sheets contains information on Project Identification, Hole or Pit Identification, Location and Elevation. The main section of the logs contains information on methods and conditions, material substance description and structure presented as a series of columns in relation to depth below the ground surface which is plotted on the left side of the log sheet. The common depth scale is 8m per drill log sheet and about 3-5m for excavation logs sheets.

As far as is practicable the data contained on the log sheets is factual. Some interpretation is inevitable in the identification of material boundaries in areas of partial sampling, the location of areas of core loss, description and classification of material, estimation of strength and identification of drilling induced fractures. Material description and classifications are based on SAA Site Investigation Code AS 1726 - 1993 with some modifications as defined below.

These notes contain an explanation of the terms and abbreviations commonly used on the log sheets.

DRILLING

Drilling & Casing

ADV	Auger Drilling with V-Bit
ADT	Auger Drilling with TC Bit
WB	Wash-bore drilling
RR	Rock Roller
NMLC	NMLC core barrel
NQ	NQ core barrel
HMLC	HMLC core barrel
HQ	HQ core barrel

Drilling Fluid/Water

The drilling fluid used is identified and loss of return to the surface estimated as a percentage.

Drilling Penetration/Drill Depth

Core lifts are identified by a line and depth with core loss per run as a percentage. Ease of penetration in non-core drilling is abbreviated as follows:

VE	Very Easy
E	Easy
M	Medium
H	High
VH	Very High

Groundwater Levels

Date of measurement is shown.

Standing water level measured in completed borehole

Level taken during or immediately after drilling

D	Disturbed
B	Bulk
U	Undisturbed
SPT	Standard Penetration Test
N	Result of SPT (sample taken)
PBT	Plate Bearing Test
PZ	Piezometer Installation
HP	Hand Penetrometer Test

EXCAVATION LOGS

Explanatory notes are provided at the bottom of drill log sheets. Information about the origin, geology and pedology may be entered in the "Structure and other Observations" column. The depth of the base of excavation (for the logged section) at the appropriate depth in the "Material Description" column. Refusal of excavation plant is noted should it occur. A sketch of the exposure may be added.

MATERIAL DESCRIPTION - SOIL

Classification Symbol - In accordance with the Unified Classification System (AS 1726-1993, Appendix A, Table A1)

Material Description - In accordance with AS 1726-1993, Appendix A2.3

Moisture Condition

D	Dry, looks and feels dry
M	Moist, No free water on remoulding
W	Wet, free water on remoulding

Consistency - In accordance with AS 1726-1993, Appendix A2.5

VS	Very Soft	< 12.5 kPa
S	Soft	12.5 – 25 kPa
F	Firm	25 – 50 kPa
St	Stiff	50 – 100 kPa
VSt	Very Stiff	100 – 200 kPa
H	Hard	> 200 kPa

Strength figures quoted are the approximate range of undrained shear strength for each class.

Density Index. (%) is estimated or is based on SPT results.

VL	Very Loose	< 15 %
L	Loose	15 – 35 %
MD	Medium Dense	35 – 65 %
D	Dense	65 – 85 %
VD	Very Dense	> 85 %

MATERIAL DESCRIPTION -ROCK

Material Description

Identification of rock type, composition and texture based on visual features in accordance with AS 1726-1993, Appendix A3.1-A3.3 and Tables A6a, A6b and A7.

Core Loss

Is shown at the bottom of the run unless otherwise indicated.

Bedding

Thinly Laminated	< 6 mm
Laminated	6 - 20
Very Thinly Bedded	20 - 60
Thinly Bedded	60 - 200
Medium Bedded	200 – 600
Thickly Bedded	600 – 2000
Very Thickly Bedded	> 2000

Weathering - No distinction is made between weathering and alteration. Weathering classification assists in identification but does not imply engineering properties.

Fresh (F)	Rock substance unaffected by weathering
Slightly Weathered (SW)	Rock substance partly stained or discoloured. Colour and texture of fresh rock recognisable.
Moderately Weathered (MW)	Staining or discolouration extends throughout rock substance. Fresh rock colour not recognisable.
Highly Weathered (HW)	Stained or discoloured throughout. Signs of chemical or physical alteration. Rock texture retained.
Extremely Weathered (EW)	Rock texture evident but material has soil properties and can be remoulded.

Strength - The following terms are used to described rock strength:

Rock Strength Class	Abbreviation	Point Load Strength Index, Is(50) (MPa)
Extremely Low	EL	< 0.03
Very Low	VL	0.03 to 0.1
Low	L	0.1 to 0.3
Medium	M	0.3 to 1
High	H	1 to 3
Very High	VH	3 to 10
Extremely High	EH	≥ 10

Strengths are estimated and where possible supported by Point Load Index Testing of representative samples. Test results are plotted on the graphical estimated strength by using:

° Diametral Point Load Test

Axial Point Load Test

Where the estimated strength log covers more than one range it indicates the rock strength varies between the limits shown.

MATERIALS STRUCTURE/FRACTURES

ROCK

Natural Fracture Spacing - A plot of average fracture spacing excluding defects known or suspected to be due to drilling, core boxing or testing. Closed or cemented joints, drilling breaks and handling breaks are not included in the Natural Fracture Spacing.

Visual Log - A diagrammatic plot of defects showing type, spacing and orientation in relation to core axis.

Defects	———	Defects open in-situu or clay sealed
	– – – – –	Defects closed in-situ
	.....	Breaks through rock substance

Additional Data - Description of individual defects by type, orientation, in-filling, shape and roughness in accordance with AS 1726-1993, Appendix A Table A10, notes and Figure A2.

Orientation - angle relative to the plane normal to the core axis.

Type	BP	Bedding Parting
	JT	Joint
	SM	Seam
	FZ	Fracture Zone
	SZ	Shear Zone
	VN	Vein
	FL	Foliation
	CL	Cleavage
	DL	Drill Lift
	HB	Handling Break
	DB	Drilling Break
Infilling	CN	Clean
	X	Carbonaceous
	Clay	Clay
	KT	Chlorite
	CA	Calcite
	Fe	Iron Oxide
	Qz	Quartz
	MS	Secondary Mineral
	MU	Unidentified Mineral
Shape	PR	Planar
	CU	Curved
	UN	Undulose
	ST	Stepped
	IR	Irregular
	DIS	Discontinuous
Rougness	POL	Polished
	SL	Slickensided
	S	Smooth
	RF	Rough
	VR	Very Rough

SOIL

Structures - Fissuring and other defects are described in accordance with AS 1726-1993, Appendix A2.6, using the terminology for rock defects.

Origin - Where practicable an assessment is provided of the probable origin of the soil, eg fill, topsoil, alluvium, colluvium, residual soil.

Appendix B

IMPORTANT INFORMATION

Important Information

This Document has been provided by Morrow Geotechnics Pty Ltd subject to the following limitations:

This Document has been prepared for the particular purpose outlined in Morrow Geotechnics' proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose.

The scope and the period of Morrow Geotechnics' Services are as described in Morrow Geotechnics' proposal, and are subject to restrictions and limitations. Morrow Geotechnics did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Document. The scope of services may have been limited by such factors as time, budget, site access or other site conditions. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Morrow Geotechnics in regards to it. Any advice given within this document is limited to geotechnical considerations only. Other constraints particular to the project, including but not limited to architectural, environment, heritage and planning matters may apply and should be assessed independently of this advice.

Conditions may exist which were undetectable given the limited nature of the enquiry Morrow Geotechnics was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required. No geotechnical investigation can provide a full understanding of all possible subsurface details and anomalies at a site.

In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. Morrow Geotechnics' opinions are based upon information that existed at the time of the production of the Document. It is understood that the Services provided allowed Morrow Geotechnics to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

Any assessments made in this Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Document.

Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Morrow Geotechnics for incomplete or inaccurate data supplied by others.

Where ground conditions encountered at the site differ significantly from those anticipated in the report, either due to natural variability of subsurface conditions or construction activities, it is a condition of the report that Morrow Geotechnics be notified of any variations and be provided with an opportunity to review the recommendations of this report.

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